CO IR Controls

(WBS 2.5)

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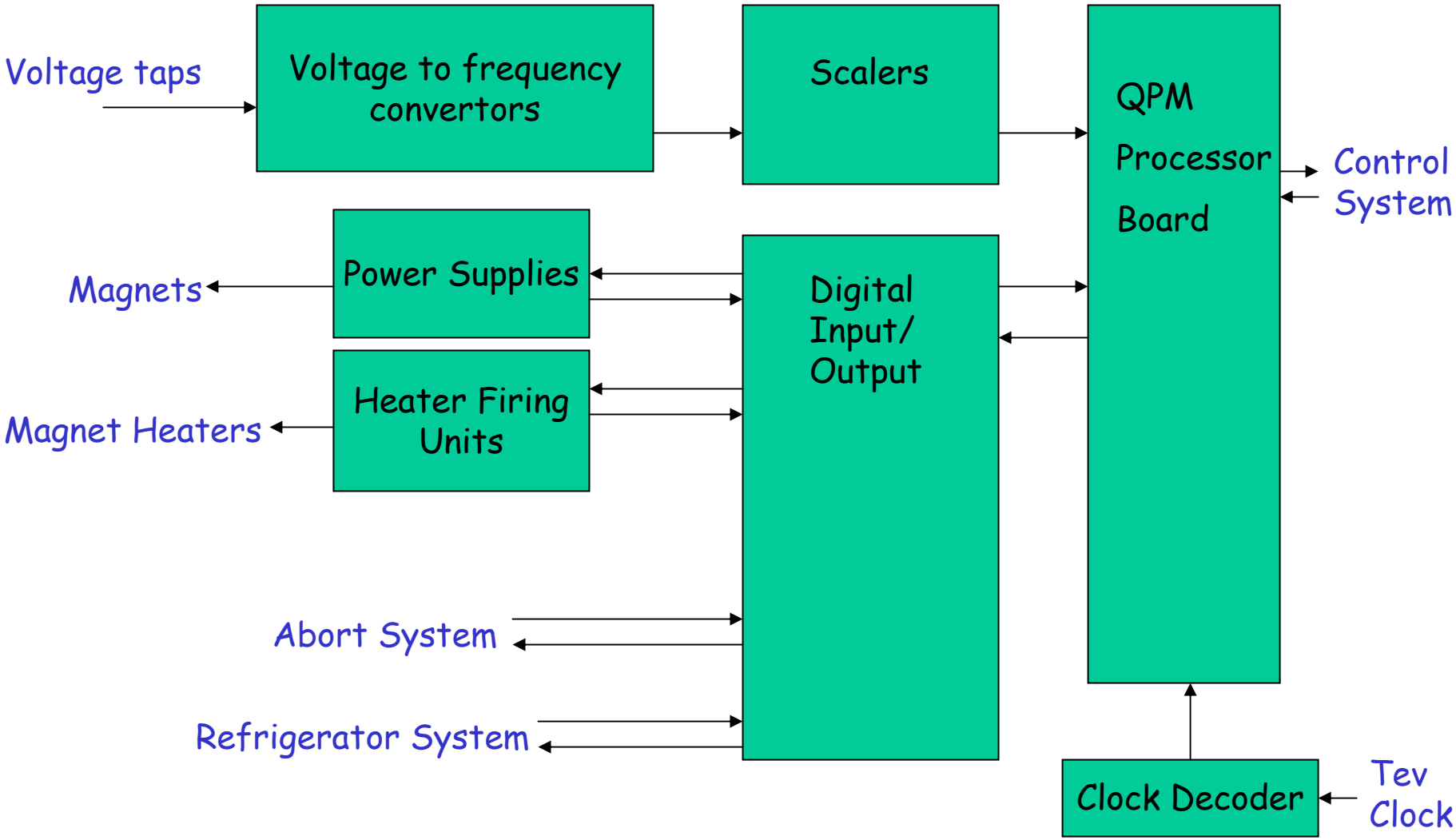
Scope

- Quench Protection for Interaction Region Quads
- Quench Protection for Tevatron
- Collimator Controls
- Separator Controls
- Corrector Power Supply Controls
- Vacuum Controls
- Abort System Interface
- Quadrupole Power Supply Controls
- Application Software and Database Entry

Quench Protection System Block Diagram



Quench Protection for IR Quads

- Three new Quench Protection Monitors Required
  - Hardware the same as B0/D0 QPMs
    - VME64 crate
    - Motorola Processor board running VxWorks real time operating system
    - Digital and Analog I/O on PCI Mezzanine cards
    - Connections made through Transition Modules (Universal Breakout Boards)
  - Software modifications to reflect different number of circuits, voltage taps and power leads
  - Quench Detection Algorithm, Power Leads monitoring algorithm, Circular Buffer size and structure, etc. remains the same as in Tevatron and B0/D0 QPMs
  - Application program presently used to interface B0/D0 QPMs will be extended to include C0, C1 and B4 QPMs

Quench Protection for IR Quads– Cont.

- Uninterruptable Power Supplies
  - Same as used in the Tevatron
- Heater Firing Units
  - Q6 and Q7 will use Tevatron Heater Firing Units
  - Q1-Q5 will require new Heater Firing Units
    - LHC voltage and capacitance
    - Larger power supply to charge capacitor bank faster than LHC
    - Tevatron style QPM interface
- Voltage to Frequency Convertors
  - Same design as used in the Tevatron
- Cabling
  - Voltage taps and Heater cables

Tevatron QPM Modifications

- Minor Changes required to the B4 and C1 Tevatron Quench Protection Monitors
  - One additional Heater Firing Unit
  - High Temperature Superconducting Power Leads added
  - Dipoles re-arranged

Additional Controls Hardware Required

System	Items	Description	#
Vacuum	Crate,PS & Interface	For Separator Vacuum	1
Power Supplies	c460	Corrector control card	16
	c468	Quad PS control card	9
Abort	c200	Abort Input module	3
Collimators	Crate & PS	Motion control crate	1
	Motor PS	Power source for motors	1
Separators	c185	Digital Status card	6
	c465	Waveform generator	3
	c052	On/Off control	3
Misc Camac	crate	Additional crate at B4	1
	C290 & MADC	Additional analog inputs	1

Controls Application Software Modifications

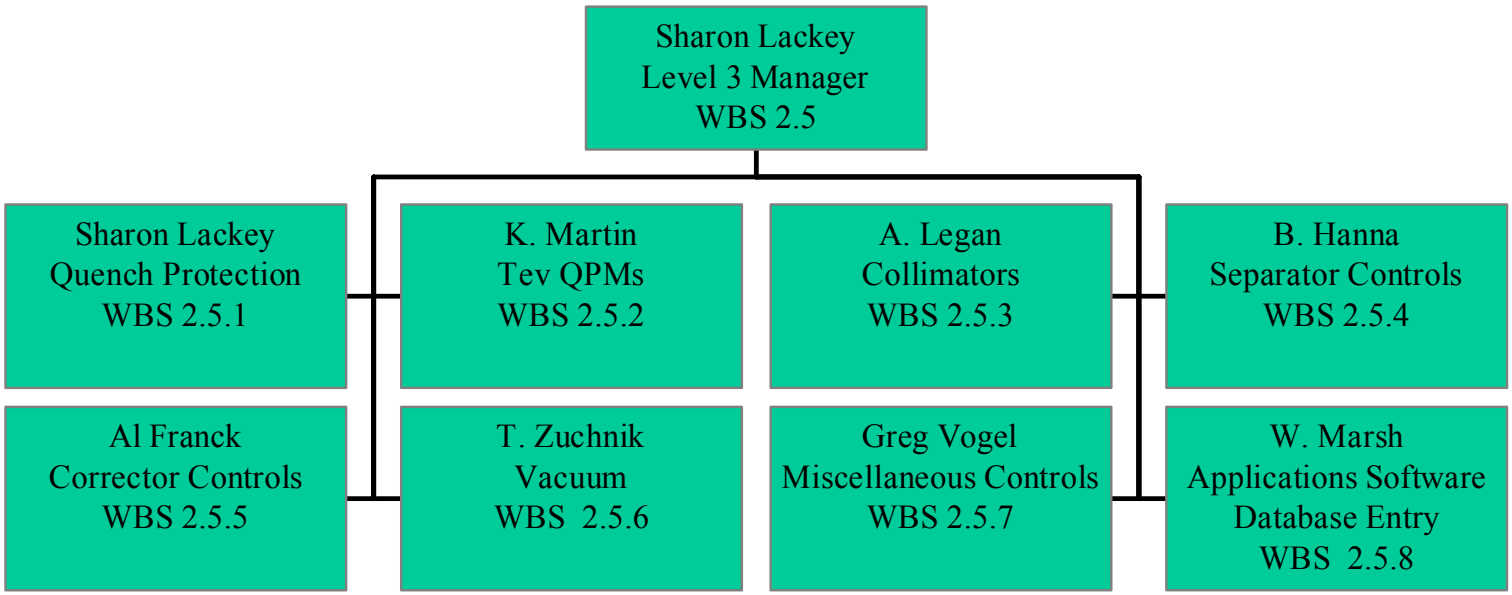
Program Name	Description	Changes
Low Beta QPM	Operator interface to QPMs	Add B4,C0 & C1 QPMs
Tev LCW (T12)	Operator interface to Low Conductivity Water System	Add new devices; modify graphics
Tev PS Status (T21)	Tevatron Power Supply Status and Control	Add C0 IR Quad Power Supplies
Tevatron Orbit (C50)	Tevatron Orbit Smoothing	Add new BPMs
Tev Vacuum (T18)	Tevatron Vacuum interface	Add separator vacuum devices
Tev Abort Status(T67)	Abort Status and control	Add c200 at B4,C0 & C1
Tev Ramp Build(C49)	Generates all Tev Ramps	Add C0 IR PSs, Correctors & new squeeze
Tev Sequencer (C48)	Automates Shot Setup	Add C0 IR Squeeze
Tev Separators (C13&C15)	Separator status, control and bake-out	Add new separators
Scraping Program (C10)	Operator Interface to Collimators	Add new Collimators
ADC Compare (C23)	Save, Compare & Restore of parameters	Add new devices
DFG (I15)	Operator interface to 4xx modules	Add new modules
Tev Magnet Database (T126)	Keeps track of magnets & spares	Add new magnets

Other Software Modifications

Program	Changes needed
QPM Front end code	Modification for B4, C0 and C1 QPM
Vacuum Front end code	Addition of CIA crate for separator vacuum
Collimator Front End code	Adjust algorithms for new collimator
Tev Low Level RF Front End code	Change in Tevatron Orbit length
Refrigerator Front End	Added cryogenic instrumentation
TEVCOL (Open Access Client)	Add new collimator
GLFRIG (Global Refrigerator Open Access Client)	Addition of new Cold Compressor calculation for B4 & C1
CBSHOT (Open Access Client)	Addition of Shot Data Analysis data for C0
MCRVCR (Open Access Client)	Addition of recording of video signals of C0 data for SDA
VLOGGR (Open Access Client)	Addition of new Tevatron State transition

Organization and Management

WBS 2.5 - CO IR Controls



Schedule

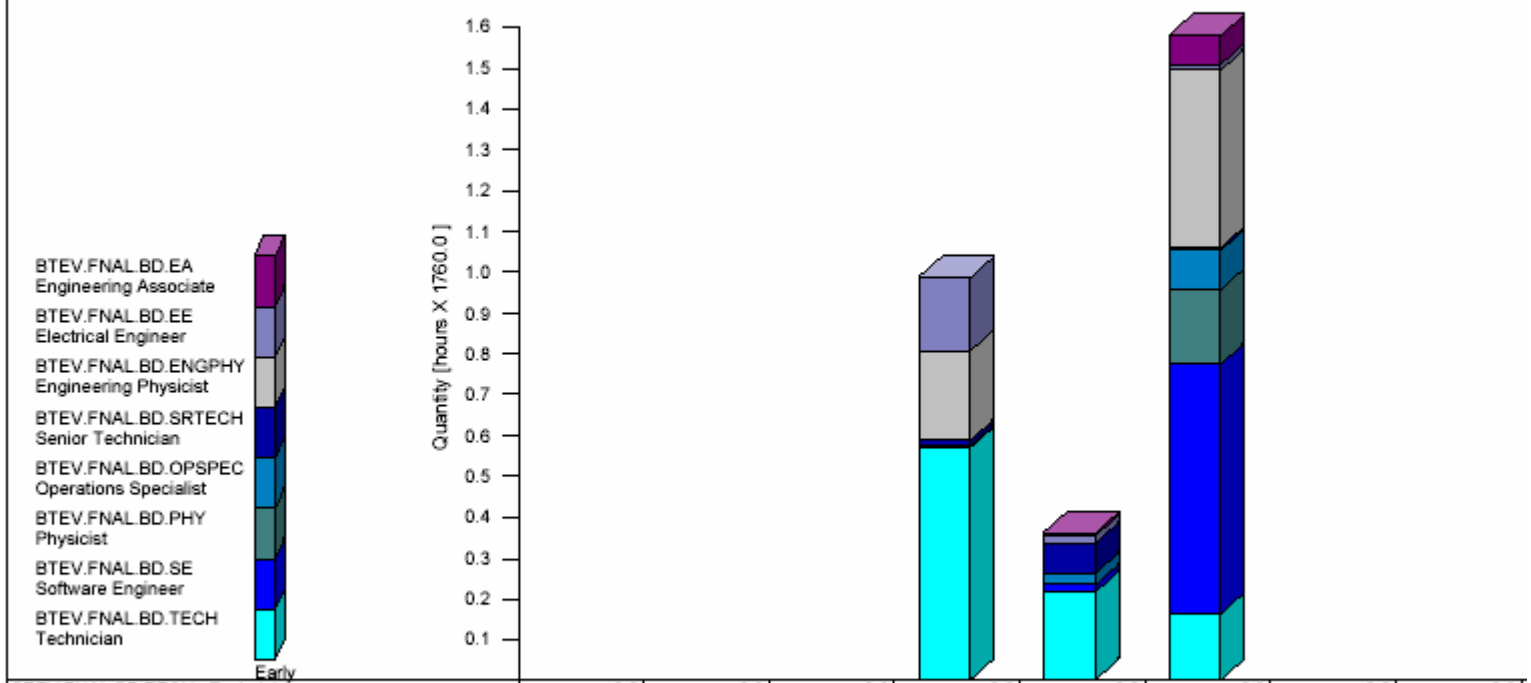
- Controls work will begin FY07 to help match the funding profile
- Effort is spread over multiple departments and groups and will not be a large burden on any particular group or person

Schedule WBS 2.5

Activity ID	Activity Description	FY06	FY07	FY08	FY09	FY10
5	Controls	5				
5.1	New low beta QPM system	5.1				
5.2	Tevatron QPM modifications				5.2	
5.3	collimators controls			5.3		
5.4	separator controls			5.4		
5.5	Corrector controls			5.5		
5.6	vacuum controls			5.6		
5.7	miscellaneous controls				5.7	
5.8	software modifications				5.8	

Labor Profile by Fiscal Year (FTE's) WBS 2.5

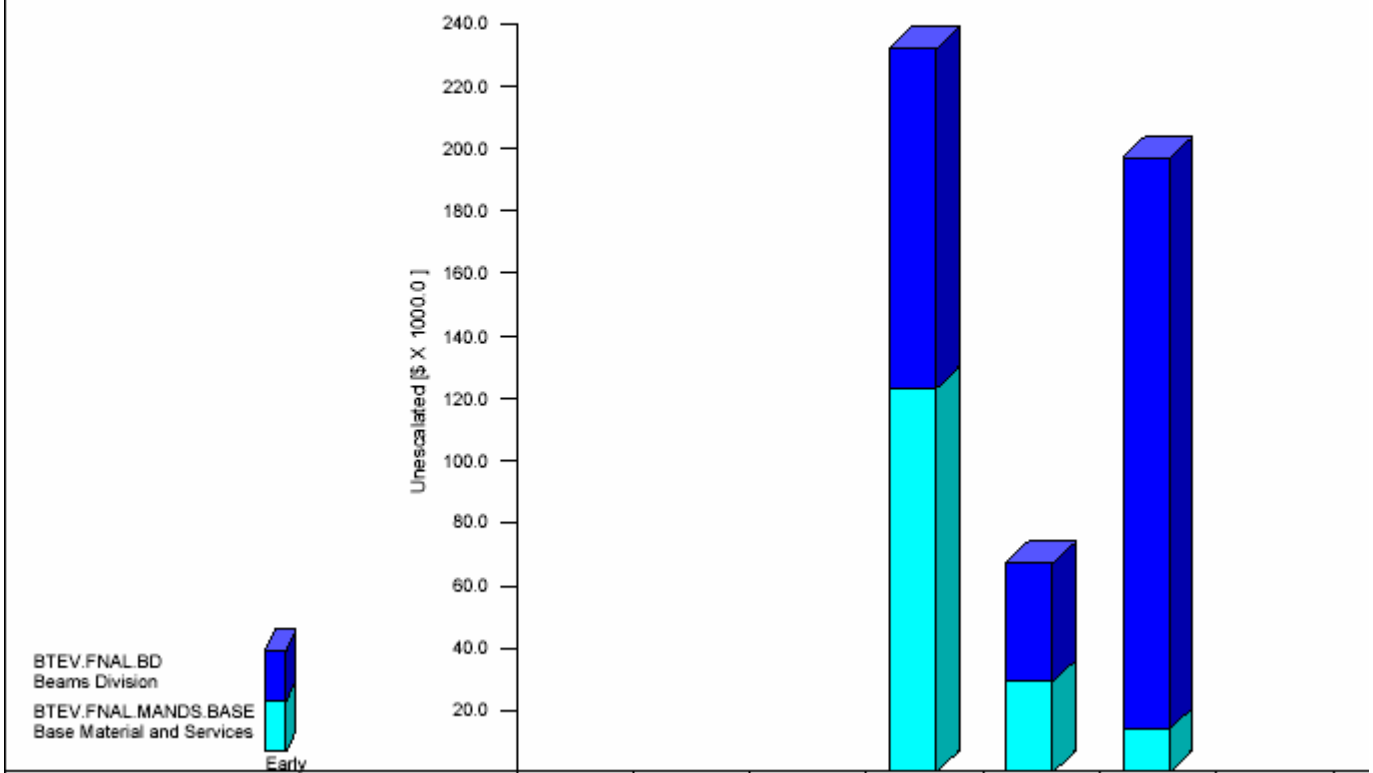
Activity ID	Activity Description	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11
5	Controls				5				



BTEV.FNAL.BD.TECH : Technician	0.0	0.0	0.0	0.6	0.2	0.2	0.0	0.0
BTEV.FNAL.BD.SE : Software Engineer	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0
BTEV.FNAL.BD.PHY : Physicist	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
BTEV.FNAL.BD.OPSPEC : Operations Specialist	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
BTEV.FNAL.BD.SRTECH : Senior Technician	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
BTEV.FNAL.BD.ENGPHY : Engineering Physicist	0.0	0.0	0.0	0.2	0.0	0.4	0.0	0.0
BTEV.FNAL.BD.EE : Electrical Engineer	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
BTEV.FNAL.BD.EA : Engineering Associate	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Total Obligation Profile by Fiscal Year WBS 2.5

Activity ID	Activity Description	FY04	FY05	FY06	FY07	FY08	FY09	FY10
5	Controls				5			



BTEV.FNAL.MANDS.BASE : Base Material and Services	0.0	0.0	0.0	122.8	29.0	13.9	0.0
BTEV.FNAL.BD : Beams Division	0.0	0.0	0.0	108.9	38.0	183.1	0.0

Construction Obligation Breakdown WBS 2.5

WBS	Subproject	M&S (K$)	labor (K$)	total (K$)
2.5.1	Low beta QPM system	122.8	108.9	231.7
2.5.2	Tevatron QPM mods	0.0	6.5	6.5
2.5.3	collimator controls	3.0	1.7	4.7
2.5.4	separator controls	10.3	8.8	19.1
2.5.5	corrector controls	13.0	16.1	29.1
2.5.6	vacuum controls	2.7	11.4	14.1
2.5.7	miscellaneous controls	13.9	26.9	40.8
2.5.8	software modifications	0.0	149.7	149.7
	Total	**165.7**	**330.0**	**495.7**

Risk Analysis

Risk:	Mitigation:
▪ Q6 and Q7 paucity of voltage taps ➢ Using existing magnets with only one center tap in single magnet circuits	▪ Will compare the two halves of the magnet. This has been done in the experimental areas.
▪ HFU cost ➢ LHC HFU costs are hard to apply as they made 6500 units and had them assembled in India	▪ Included a large contingency for this item

Summary

- All required hardware is same as Tevatron designs except for LHC style heater firing units.
- Software changes are well understood and resources will be available